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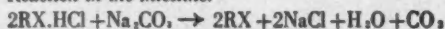
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¹Kraemer, M.: Postgrad. Med. 2:431 (Dec.) 1947.

²Kraemer, M., and Siegel, L.H.: Arch. Surg. 56:318 (Mar.) 1948.

³Martin, G. J., and Wilkinson, J.: Gastroenterology 6:315 (Apr.) 1946.

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An Evaluation of Some Procedures Used in Multiphasic Screening

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THE concept of multiphasic screening, although relatively new to public health practice, has been a part of general medical practice for many years. In the general work-up of patients presenting complaints, it has been the policy of the better practitioners—stimulated by their training in medical schools and in the teaching hospitals, as well as in well managed clinics and hospitals both public and private—to seek out history and to perform physical examinations and laboratory tests unrelated to the complaints, not to add criteria to data related to the complaints for formulation of a diagnosis, but to discover a new manifestation of disease requiring deeper investigation for a diagnosis. This is truly screening, for that term implies the more or less routine application, regardless of symptoms and individual indications, of a procedure which will detect abnormalities or suggestive changes and bring them to recognition for further complete study. "Routine" procedures of medical practice are in this category, the routine Wassermann test, hemoglobin or urinalysis, and the routine chest film.

More recently, stimulated by individual programs of Wassermann testing, mass microfilm surveys for tuberculosis and heart disease, and campaigns of the American Diabetes Association for urine and blood testing for glucose, certain groups (1, 2, 3) have combined varying numbers of these and other procedures, especially those which can be carried out without physician personnel or with minimal participation by physicians, into multiphasic screening programs. These vary from a combination of chemical urinary tests

(protein and sugar), blood examinations (sugar, Wassermann, hemoglobin) and chest x-rays (usually microfilms) to surveys which have included history-taking devices, varying degrees of physical examination, special tests for sight and hearing, electrocardiography and other procedures.

Since April, 1946, the Department of Tropical Medicine and Public Health of the Tulane University School of Medicine has operated a clinic set up primarily for the detection of cancer. The procedures carried out in that clinic include all those usually thought necessary for adequate study of a patient who is "gone over" generally. Indeed, the survey is made by physicians from the departments of medicine, surgery and gynecology with help from the clinical laboratories, x-ray and other services necessary. The examination of each patient includes a complete history (compared in a number of instances picked at random with the Cornell Medical Index, a complete general physical examination with rectal and complete genital examinations for each sex, a complete blood count, Wassermann test, urinalysis (on catheterized urine in females), and a chest x-ray. Papanicolaou stains are done on uterine cervical specimens in females. Additional procedures are obtained as indicated, and the examinees are referred to the physician or clinic of their own choice for final diagnosis. Follow-up investigations are carried out to note, first, if the findings discovered were carried to completion in diagnosis by the private physician, and, second, if any evidences of disease appeared which might have been overlooked in the examination.

The subjects accepted for examination consist of all those applying for admission regardless of economic status. They represent largely those persons seen by the general practitioners of the area, to whom they are referred if abnormalities are found. Approximately 7 per cent are Negro, 25 per cent males, and 85 per cent above thirty years of age. In accord with the wishes of the local medical society, no person is taken for examination if definite symptoms are known. However, a small and unknown percentage of patients with symptoms enter the clinic for they deny symptoms on admission. Most of these, to our knowledge, are persons with vague symptoms who, after talking over the examination with friends who have gone through the clinic, decide to apply for examination. A small number also, we know, are sent by physicians because of the adequacy of the work-up. All the above factors have a definite influence on the findings in the clinic and make it difficult to compare this group with others chosen on different criteria.

It is not the purpose of this report to compare the results with those of other clinics in terms of positive findings, but to establish, if possible, the importance of certain aspects of the examination. It is perfectly clear that, with the studies outlined above, the data can be analyzed to note (1) which of the procedures commonly used in screening, and included in this study, were responsible for detection of abnormalities, (2) how much of, and which type of, disease found could have been detected without physician personnel, (3) with the application of varying combinations of procedures used in screening, which important diseases would remain undiscovered.

In the entire group there were 2,971 persons. The findings suggestive of certain diseases which are of great importance in morbidity and mortality

and also which are often insidious in onset are listed in Table I. The reasons for the analysis of these particular findings in this report are discussed below.

In the entire series of 2,971 persons examined, there was a group of 185 (6.2 per cent) with various findings such as vague dyspepsia, changes in bowel habits, palpable masses, non-healing lesions, x-ray shadows, etc., which caused suspicion of malignant disease. Of this group 27 (or 0.91 per cent of all) were definitely proved to have malignant disease. Since follow-up studies were not complete in all patients, this figure is a minimal one. Of the 27, 9 (lung, breast, cervix) were not suspected before admission to the clinic, the remainder (skin, breast, colon, cervix) being sufficiently symptomatic to

TABLE I
FINDINGS INDICATIVE OF DISEASE IN 2,971 EXAMINATIONS*

Findings suggestive of a malignant growth	185
Findings indicative of premalignant lesions	115
Finally diagnosed malignant disease	27
Evidences of heart disease	148
Diastolic hypertension without evidence of cardiac involvement	130
Blood hemoglobin of 11 Gm. or less	115
Urinary findings worthy of investigation	213
Albuminuria	64
Glycosuria	63
Pyuria	52
Casts	34
X-ray evidence of active pulmonary tuberculosis	9
X-ray evidence of questionably active tuberculosis	10
Positive Wassermann reaction	7

*See text.

suggest the diagnosis. Even so, history and physical examination were important in all diagnoses except 4, 2 being bronchogenic and 2 cervical carcinomas. In the latter 2, the Papanicolaou test was positive and was the clue to diagnosis. In 6 carcinomas of the cervix, physical examination without the Papanicolaou test was sufficiently suggestive to justify biopsy. The Papanicolaou test cannot be considered an isolated laboratory procedure, even though positive in 2 cases with no other evidence, because physical examination (gynecologic examination) is an integral part of the test. In 4 instances the Papanicolaou stain was positive when further investigation showed no cancer. In others where the Papanicolaou test was positive, final follow-up of the patient was not obtained and the percentage of false positive tests cannot be estimated.

History and physical examination were both important, therefore, in recognition of the malignant disease found, and test procedures, aside from chest x-rays in 2 instances, were not helpful unless combined with physical examination.

The findings suspected of being malignant included a number of premalignant lesions, such as benign tumors, polyps, leukoplakia, hyperkeratoses and deeply pigmented moles. Altogether, 115 lesions considered important premalignant structures were found; it is difficult to evaluate such lesions and considerable variability exists in these estimations from examiner to examiner.

In screening procedures, it is imperative that such lesions be found and criteria for further investigation should tend to be liberal.

Diastolic hypertension was present in 196 of those seen and significant damage to the heart was clinically evident in 66. Of these, 130 were, therefore, found only by physical examination and half of these were previously unrecognized. Here physical examination was the sole screening procedure of value.

Evidences of heart disease were found in 148 persons (5.0 per cent). In this group there were 24 rheumatic, 54 primarily arteriosclerotic, 66 hypertensive, 2 thyroid, and 2 congenital. Of these, 28 with arteriosclerotic, 20 with hypertensive, and 2 with rheumatic heart disease were definitely unknown before; and of these 50 cases, 40 were not picked up by x-ray. Since electrocardiograms were not routinely done, the diagnoses resulted from data obtained on history, physical examination and chest x-ray. Results clearly showed that the x-ray examination, although important in recognition of heart disease, is likely to miss early disease and to be positive chiefly in advanced cases showing remarkable changes in cardiac contour or size.

Active tuberculosis and syphilis were picked up 9 and 7 times, respectively, by chest x-ray and Wassermann tests. All these were unknown before admission to the clinic. In addition, 30 instances of questionably active tuberculosis were discovered.

The results in the above group are summarized in Table II.

TABLE II
SUMMARY OF FINDINGS IN 321 INSTANCES OF DISEASE
DETECTED IN THE PRESENT SURVEY

	Total Instances Finally Diagnosed	Total Unrecognized Previous to this Examination	Total of Those Previously Unrecognized Positive by Laboratory Tests or X-Ray
Heart disease	148	50	10
Diastolic hypertension without evident cardiac involvement	130	65	0
Malignant disease	27	9	4
Tuberculosis	9	9	9
Syphilis (positive Wassermann)	7	7	7

Other evidences of disease of importance were 115 instances of anemia (hemoglobin 11 Gm. or below), 63 of glycosuria, 64 of albuminuria, 52 of pyuria and 34 of cylindruria. Urine specimens on all females were catheterized. Analysis of all these data and follow-up studies are not complete. In the 63 instances of glycosuria, for example, only 5 new cases of diabetes mellitus have been definitely established. Final analysis of the data may raise this figure. It will be recalled that only 6 instances of unknown diabetes were found in 123 patients showing glycosuria in Wilkerson and Krall's study (4).

Other evidences of disease, such as thyroid adenomas, ulcerative colitis, amebiasis and arthritis were recognized but the subjects were in large part symptomatic and will not be discussed here. Obesity (20 per cent overweight) occurred in 10 per cent of the patients.

A more detailed analysis of the findings in the total examination has been completed in 554 consecutive examinees and is shown in Table III. Here it can be seen that findings sufficient for diagnosis or important enough to warrant referral for further work-up appeared in 310 (56 per cent) of the cases. Of this group of 310, 245 (79 per cent) had findings positive in the history and physical examination. Of these, about one-third (80, or 32.6 per cent) had findings in the laboratory and x-ray bracket, so that if the latter type of screening procedure had been done alone, two-thirds (165, or 67.4 per cent) would have been missed. On the other hand, on the basis of the laboratory and x-ray reports alone on the entire group of 554 persons, 65 persons with significant laboratory findings were discovered who had no significant findings

TABLE III

FREQUENCY OF EVIDENCE OF IMPORTANT DISEASE IN 554 EXAMINEES ACCORDING
TO (A) EVIDENCE IN HISTORY AND PHYSICAL EXAMINATION, AND
(B) EVIDENCE BY LABORATORY TEST OR SPECIAL PROCEDURE*

Total number of abnormalities	310
Total positive by history and physical examination	245
Positive by laboratory test or special procedure	80
Negative by laboratory test or special procedure	165
Total positive by laboratory and special test	145
Positive by history and physical examination	80
Negative by history and physical examination	65

*See text.

on history and physical examination. Thus, had laboratory and x-ray procedures alone been used, 145, or approximately 26 per cent of the 554, would have been picked up, 80 of whom (55.1 per cent) were positive in the history and physical examination and 65 of whom (44.9 per cent) were not. If height and weight and blood pressure determinations are added to the laboratory bracket, the number of persons detected is raised from 145 to 190, or 34 per cent of the 554 and 61 per cent of all those with abnormalities. There actually were 38 patients with obesity, 42 with hypertension, and 11 with both. Of these 45 had no laboratory findings of importance so that 45 examinees with no significant laboratory data are added.

It can be seen, therefore, that in our group of applicants for examination, the usual x-ray and laboratory procedures used in screening discovered 145 of 310 persons shown by the total examination to have significant findings. If height, weight and blood pressure, three determinations which can be done by non-physician personnel, are included, the figure rises to 190.

DISCUSSION

Although the goal of preventive medicine is the recognition and correction of deterioration of health status, the recognition of any and all disease is desirable. The importance of screening procedures rests in their detection of manifestations of unrecognized disease so that the person may be brought under observation for diagnosis, treatment and management of the disturbance. This does not imply that if a disease is symptomatic some screening procedure other than history is not important, for the symptoms may be so vague, non-

descript, or so mild that the person does not consider them of sufficient importance to demand medical advice. For example, the early evidences of bronchogenic carcinoma, such as cough, may be passed off as "cigarette cough", "chronic bronchitis", etc.

Most important in detection are those diseases which, though unrecognized, eventuate in incapacitating symptoms either of short or long duration and diseases which develop insidiously and gradually and which, unless promptly recognized, eventuate in death. If one surveys the chief causes of morbidity and mortality in this country, he will find among those important for such detection the following conditions:

Heart disease

Other vascular disturbances, including hypertension

Neoplasms

Renal diseases, especially nephritis, pyelonephritis and calculus

Tuberculosis

Diabetes mellitus

Cirrhosis of the liver

Together with appendicitis, pneumonias, cholelithiasis, accident violence, homicide and suicide and congenital and infectious diseases of infancy, all of which (except cholelithiasis) are not important as insidiously developing diseases, these conditions account for over 88 per cent of all deaths in the United States. Also, the diseases in this list, together with early syphilis and certain rheumatic states and some psychiatric disturbances, should be importantly recognized early to prevent needless suffering and permanent disability as well as death.

In the group of diseases listed above, certain conditions are important as precursors and precipitating factors. Obesity, for example, is at times an important factor in the development of hypertension and diabetes and should be sought and controlled. Similarly, underweight and other nutritional disturbances are important. Likewise, certain manifestations of disease found frequently in the diseases listed, as well as in other conditions, must be sought to screen out early instances of such disease. Anemia is such a sign, as are albuminuria and hematuria. These, together with other signs and manifestations which occur in this group of diseases, represent a part of the findings in the screening survey which should be as complete as practical in order to recognize the diseases listed above *in as early a stage as possible*.

It is possible in such a screening survey to include the following general categories of techniques (1) medical history, (2) physical examination, (3) "routine" laboratory procedures, and (4) special procedures such as the chest x-ray and the Papanicolaou stain. Our group of examinees was studied by the usual procedures employed in each of these categories, as already stated earlier in this report. Others have included all these categories in screening procedures (2) but, in large part, most surveys have included only those procedures not requiring physician participation or such participation in minor degree. In general this means that history and physical examination have received little emphasis except for skeleton histories or important items which can be answered mainly on a simple questionnaire, and only such procedures

in physical examination as height, weight, hearing, sight, and blood pressure determinations. Stress has been placed upon certain items of laboratory study and special procedures such as the chest microfilm.

The inclusion of both groups of data (history and physical examination on the one hand and laboratory findings and special procedures on the other) has permitted an analysis of our data to establish the importance of these two groups of data in uncovering disease in our examinees. It is not possible to generalize on the importance of these figures because of the variable factors in the choice of examinees, such as the number masking symptoms to gain entrance to the clinic, and the limited number of cases analyzed. It is clear, however, that the omission of history and physical examination would have reduced by over one-half (Table III) the important conditions discovered and this particularly so in cancerous, precancerous, and degenerative cardiovascular disease (Table II), conditions which lead the list of causes of death. Addition of height, weight and blood-pressure estimations increased the findings importantly (from 145 to 190 cases), but still did not pick up malignant and important premalignant lesions. We have no desirable method at present for simple mass application in detection of cancer or precancerous conditions or early degenerative vascular disease. Obviously the development of procedures which can be simply and practically applied to recognition of these diseases is necessary. Electrocardiography on the one hand and such procedures as the Papanicolaou technic on the other are helpful but cannot be applied simply on a mass basis.

We have under analysis at present an evaluation of the Cornell Medical Index (C.M.I.) (5) as a history-screening procedure for this type of examinee. In our series the history was taken by an internist in the clinic in the usual fashion. This procedure is time-consuming but, with the help of printed forms on which the examiner "checks off" certain items, the time required can be reduced to approximately twenty minutes. Quite independently of the usual clinic routine, the Cornell Medical Index was utilized on 100 persons before they were subjected to clinic routine but the C.M.I. was not made available to the examining physician. Comparison of results of the C.M.I. with those of the history taken by the physician disclosed that the C.M.I. would have acted as a screening aid in history taking and nothing of importance would have been missed by its use had it been available to the physician to shorten his time of history taking. The physician with the C.M.I. in hand can usually, in this type of examinee, reduce the time of history taking by two-thirds. However, had the C.M.I. been utilized alone and interpreted away from the examinee by a physician not seeing the subject or completing the history by personal interview, the answers would have caused needless referral of the patient in over 20 per cent of the cases. When the patient had symptomatic disease, answers to the C.M.I. would have been successful in proper referral for further work-up. This analysis will be reported in detail later.

Despite the fact that this group of examinees supposedly had no symptoms to suggest to them major disease, and in large part denied symptoms on admission to the clinic, symptomatic disease was detected, the symptoms

often being too vague or insufficient to make the examinee consider himself in need of medical advice.

The importance of historical as well as physical examination in the recognition of degenerative vascular as well as malignant disease is obvious. If screening procedures are applied to examinees without these means of detection of disease and with any implication that the individual has been examined to exclude such disease, much harm may be done.

There are several miscellaneous items of data which should be mentioned in passing, even though this report is not meant for their extensive discussion. Of importance are our data showing that of 185 persons in whom some finding suggested malignancy, only 27 were finally proved. Even though the figure 27 is a minimal one, because all instances were not followed up, a high proportion of what might be called "false positives" is evident. A similar result was obtained in the evaluation of premalignant lesions. The data on glycosuria show the same problem. The need for extensive study on screening levels to reduce the proportion of false positives is manifest. Screening levels must be liberal to detect important disease, yet still not sufficiently liberal to give a discouragingly high percentage of false positives necessitating follow-up examinations.

We do have some means of correcting these deficiencies in part. Mass examinations may and should be set up, not with a single program applicable to all age groups, all economic groups or all geographic areas. The approach should be modified to fit the specific group under consideration. For example, in our own series of 2,971 examinations, the Wassermann test was positive 7 times, but only 3 times in approximately 2,700 white patients. In this particular group it is questionable whether the returns from this procedure were sufficiently great to warrant the expenditure of time and effort. In the Negro group, the procedure was probably worthwhile. Similarly, on geographic grounds, screening for hookworm with stool surveys might or might not be desirable, and other examples could be given.

CONCLUSIONS

(1) Screening by the usual laboratory bracket and chest plate was, according to the data derived from 2,971 examinations considered in this report, extremely important in disease detection, but left a "blind spot" in the investigation in reference to important disabling and killing disease. It appears that, in our present state of knowledge of degenerative vascular and malignant disease, screening procedures must include historical and physical examination to be effective in these diseases.

(2) The need for a desirable method for simple mass application in detection of precancerous and cancerous lesions and for detection of early degenerative vascular disease is obvious.

(3) The need for further study on screening levels has been brought out.

(4) In an analysis of 554 consecutive examinees in the present study, of 310 persons showing important disease manifestations only 145 were positive to the usual laboratory procedures and chest x-ray. Selection of patients may have an important effect upon these figures.

(5) Addition of height, weight and blood pressure determinations, which could be done by personnel other than physicians, would have disclosed 91 additional persons but only 45 without some other defect which would have screened out the individual for further examination anyway. Addition of these procedures would have increased those screened out to 190, or 61 per cent of the 310 with abnormalities.

(6) The importance of the development of effective screening procedures covering historical data and the items in physical diagnosis which are essential and the discovery of procedures which will substitute for these as screening mechanisms is obvious.

(7) Multiphasic screening examinations should be modified and set up to fit specific groups under consideration, based upon age, socio-economic status, geographic area, and other factors.

REFERENCES

1. Canelo, C. K., Bissell, D. M., Abrams, H. and Breslow, L. A Multiphasic Screening Survey in San Jose. *California Med.*, 1949, 71: 409.
2. Ryder, C. F. and Gettings, V. A. Preliminary Report on the Health Protection Clinic. *New England J. Med.*, 1950, 243: 277.
3. Chapman, A. L. The Concept of Multiphasic Screening. *Pub. Health Rep.*, 1949, 64: 1311.
4. Wilkerson, H. L. C. and Krall, L. P. Diabetes in a New England Town. *J.A.M.A.*, 1947, 135: 209.
5. Brodman, K., Erdmann, A. J., Jr., Lorge, I., Wolff, H. G. and Broadbent, T. H. The Cornell Medical Index. *J.A.M.A.*, 1949, 140: 530.

Some Major Public Health Problems in Ontario

THE HONOURABLE MACKINNON PHILLIPS, M.D.
Minister of Health for the Province of Ontario
Toronto

THE Department of Health of Ontario encompasses many activities. One of the most important of these is the control of tuberculosis. As a result of co-operation on the part of individuals, voluntary organizations and the government, Ontario now has the lowest death rate from tuberculosis of any of the provinces of Canada. In 1940, for all Canada the death rate from tuberculosis was 51 per 100,000. In Ontario in that year the rate was 27 per 100,000. By 1949, the rate for all Canada had dropped to 30 per 100,000, while the Ontario rate had dropped to 15. Thus in a ten-year period the Ontario death rate from tuberculosis dropped from 27 to 15 per 100,000.

We now operate four permanent chest clinics with x-ray installations. At other centres where there are no x-ray facilities, regular visits are made by staff members who use portable x-ray equipment. Members of the Tuberculosis Division of the Department of Health also supervise work done at local chest clinics. The cost of the films used at these clinics is met by the sale of Christmas Seals.

A recent and most interesting development is the program for community mass surveys for tuberculosis. Here, the Department of Health provides the apparatus and the medical and technical personnel. Local committees share the costs. Through this program more than 257,000 persons were examined in 1949.

Facilities for the active treatment of tuberculous patients are available in fourteen sanatoria with a capacity of 4,059 beds. These sanatoria are self-governing, non-profit organizations operated by boards of directors. Through the Health Department the Ontario Government contributes to their upkeep by the payment of maintenance grants which vary according to the service rendered, ranging from \$3.35 per patient per day up to \$4.36 per day. In 1949, the provincial government contribution exceeded four and a half million dollars.

In addition, assistance is given by the Province toward building costs of sanatoria, under a recently adopted and standardized system of capital grants. Provincially the grant is \$2,500 per bed, and the federal government pays a capital grant of \$1,500 per bed. The provincial government's share is limited to 50 per cent of the total cost of new construction and the federal share to one-third of the total cost of such construction.

Based on a radio address given over the Canadian Broadcasting Corporation network on January 8, 1951.

MENTAL ILLNESS

In the province today there are more than 17,000 patients in the 15 Ontario Hospitals. These hospitals for the mentally ill are built, maintained, staffed and operated at provincial expense. Here is one of our most important, and indeed urgent problems. Five cents out of every dollar of provincial revenue is spent on mental health and mental hospital services. Twenty-seven per cent of the permanent members of the public service are employed full-time in this work. We may well wonder where this will end.

A survey has indicated that four persons out of every thousand of our population are inmates of mental hospitals. Each year the number of new patients admitted is about 4,000. Our situation here is no worse and probably somewhat better than elsewhere in Canada and the United States. Nevertheless, the problem is a serious one, and my hope is to accomplish something in the way of prevention. Before embarking on a costly program for bigger and more numerous mental hospitals, I think we may well concentrate on research and preventive mental hygiene at the community level.

Seventeen per cent of the patients in our mental hospitals are over the age of sixty-five. Twenty-three per cent fall within the mentally defective class, and of the balance about 8,000 fall within the schizophrenic group. This latter class of patient tends to enter an Ontario Hospital in middle life, probably at around age 45. Most of these people actually have been mentally ill in some degree for 20 or 30 years. If they had been treated in their earlier years, a great many of them would not have required mental hospital care.

We believe that our first requirement is to plan to help our citizens to avoid the necessity for mental hospital care and treatment. This can best be done within the community. We see here a field for the consultant psychiatrist. He will live in the community, and he will work with a nurse, a psychologist and a social worker. This team will provide an educational, diagnostic and treatment service. Most of this program is in the planning stage, but we have already made a start.

In the new St. Catharines Hospital, 21 beds have been set aside for psychiatric patients. Also, there will be provision for an adequate out-patient service. This experiment will be in charge of Dr. H. D. Mitchell, a physician of wide experience in mental health.

No preventive service will keep all patients out of mental hospitals. At the same time, the experiment now under way, and to be enlarged, will, if successful, pay magnificent dividends in money, and even more important—in happiness.

The Ontario Hospital at Woodstock provides care and treatment for epileptic patients, and also treats mentally ill patients who suffer from tuberculosis. I sincerely believe that the tuberculosis-prevention program in our Ontario Hospitals embodies standards that are not surpassed elsewhere on this continent.

At Orillia the Ontario Hospital and School cares for more than 2,000 mental defectives. Overcrowding there has been relieved by the opening of an additional unit at Aurora. At Cobourg a large residence will be used as an annex to the mental hospital there, and will house 65 elderly female patients.

Eastern Ontario will be served by the opening of a new Hospital and School for mental defectives at Smiths Falls. This completely new hospital will ultimately accommodate 2,400 patients. Most patients will be children, many of them urgently in need of institutional care and specialized training.

I cannot speak too highly of the members of the staffs of our Ontario Hospitals. Their devotion to duty, often under most trying circumstances, has kept our services at a high level, and has been of the utmost value to our patients.

PUBLIC HOSPITAL FACILITIES

Ontario has a rapidly increasing population. The people are making fuller use of our hospital facilities than in past years, and this tendency is increasing as more and more of our citizens enrol in one of the plans of hospital insurance. By 1947, it had become apparent to the provincial government that some practical and systematic form of aid must be given to local hospital boards to enable them to expand their facilities. Here, we broke new ground in Ontario by adopting a system of capital grants-in-aid. In brief, the province undertook to pay \$1,000 per bed for new construction related to active treatment hospitals and \$2,000 per bed for hospitals for the chronically ill.

Apart from mental institutions, there are about 22,000 public hospital beds in Ontario. When the 111 projects now in their various stages reach completion, about 10,000 additional beds will become available. Up to the present time the provincial commitments for these capital or construction grants amount to \$12,800,000.

We have also increased our maintenance grants. In 1939, operating costs of public hospitals amounted to \$13,000,000; while in 1949 costs had risen to \$51,000,000. During the same period the number of patients treated and the number of staff both doubled. The provincial maintenance grants to public hospitals rose from \$1,400,000 in 1939 to \$6,600,000 in 1949—an increase of 371.68 per cent.

In speaking of our public hospitals, we must not forget the contributions of the municipalities. They have statutory responsibilities that have been increased from time to time, and they also ordinarily meet deficits and certain fixed charges. In 1949 the municipal contribution was \$1,700,000 more than in 1939, an increase of 54.76 per cent.

Speaking generally, I should point out that the care of the mentally ill, the epileptic and the mental defective is traditionally a provincial responsibility, while the care of the physically ill, if unable to pay their own way, has been in the first instance a municipal responsibility. However, as I have shown, the Province on an increasing scale has endeavoured to aid the hospitals and to lighten municipal responsibility. Here, as elsewhere, our policy is to do what we can to lighten the burden of taxation on homes and farms.

The excellence of our public hospitals depends on many factors. In the main, these institutions of healing are community projects enjoying the largest measure of local autonomy—thus commanding a maximum of local interest and support. If we assist our hospitals in their necessary program of expansion, and in meeting their heavy costs of operation, then I shall feel that the Health Department has made a most worthy contribution to the welfare of all the people.

Community Education for Mental Health

CHRISTIAN SMITH

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COMMUNITY education for mental health is already so much a concern of public-health workers that much of what one can say here is almost common knowledge. Education for mental health has been an integral part of the work of successful health officers, public-health nurses, and health educators. Certainly, it is not new. But we recognize a need of greater emphasis. It is not a simple subject. Because of its complexities it is well to appraise the problems it poses so as to give better direction to our thinking, as a basis for possible action.

One doesn't need to argue that mental-health education is necessary and that it is a responsibility of public-health workers. It may be assumed that program interpretation is needed if the public is to gain intelligent understanding. Such understanding may be expected to encourage support of program, allocation of public moneys, and, additionally, stimulate intelligent public use of the services provided.

It may be assumed, further, that the education and motivation of the public in the direction of higher standards of health involves emotional and mental as well as physical goals.

To the health educator, the mental-health problem presents three main facets. In point of numbers apparently involved, mental and nervous disorders constitute Canada's greatest public-health problem. The 50,000 acutely or chronically ill persons in our institutions are but a fraction of the people who are suffering from poor mental health. Thus, while much needs to be done for the improvement and expansion of services in the relatively small group with recognized illness, we are much concerned with the much larger number in the community who are in need of help. Thirdly, we are newly placing emphasis on development of positive mental health.

While our people have become increasingly prevention-conscious, the concept of positive health will require much interpretation before it will be widely accepted. It seems advisable to go from the known to the unknown, and in public education for mental health we may have to use the well-known labels of treatment and prevention. It is difficult to apply prevention to emotional conditions as we do in the case of physical conditions; nevertheless, earlier diagnosis and treatment, utilization of services, and the inculcation of mental-health principles are all in a sense preventive.

Presented before the Public Health Education Section at the thirty-eighth annual meeting of the Canadian Public Health Association, held in the King Edward Hotel, Toronto, June 12-14, 1950, in conjunction with the first meeting of the Ontario Public Health Association.

At the time this paper was given, the author was director of public information for the Canadian Mental Health Association, Toronto.

Whatever our approaches may be, and no matter what labels we give some aspects of our efforts, the fact remains that in a country made prevention-conscious by demonstrated success in the control of physical ills, the challenge for leadership in the mental-health field is on the doorstep of every public-health department and of each voluntary agency working for the public welfare.

Public hunger for information and guidance has grown apace in recent times. The fact that the public has turned to many sources of information, including some of doubtful validity, does not relieve public-health departments of their responsibility; and it points to missed opportunities. However, the task is so great that all recognized community resources should be mobilized to do it.

The Canadian Mental Health Association (formerly the National Committee for Mental Hygiene, Canada) has coined a phrase: "Mental Health is everybody's job." In the past it has been anybody's job and nobody's in particular.

Psychiatry has been preoccupied with treatment and care of those whose recognized illness brought them to institutions or private practitioners for help. Lately it has widened its horizons to permit much greater attention to treatment of neuroses. Lay and professional individuals, here and there, have given time to interpretation and education.

It should be noted that there are some psychiatrists who do not agree that the public should be informed, even as a prerequisite to better support of treatment services. A few psychiatrists are content to continue work in relative isolation from the community amid unsatisfactory conditions which are largely the result of such isolation.

However, in professional groups, the psychiatrists of the United States and Canada have come out of their corner. They have recognized the field as one for multi-disciplinary action, and, moreover, they have come out strongly for education of the public. They want public education and public participation in a conviction that ignorance, fear, prejudice, and apathy are big obstacles to progress in the mental-health field. The organized psychiatrists see an informed electorate as at the very least having a beneficial effect upon legislative appropriations and on standards of care and treatment.

The American Psychiatric Association, to which most Canadian psychiatrists belong, now has a committee on public education.

The Group for the Advancement of Psychiatry, spearheading progress, includes well-known Canadian and American leaders. This group is particularly sensitive to community factors and to domestic and international mental-health problems. The members are exceptionally community-minded. Here again, public education, and public relations as well, are topics of vital interest. A Canadian Psychiatric Association is in process of organization.

To these professional bodies, and to their individual members in various spheres of authority and emphasis, all those in mental-health education look for scientific leadership and direction.

To bridge the existing gulf between psychiatry and those it can help, there are a number of semi-professional voluntary groups. In these the common pattern is multi-disciplinary, psychiatrists, psychologists, sociologists,

social workers, educators, and others working together. Both in the United States and in Canada the active partnership of the people is being sought.

In the United States the parent voluntary organization is The National Committee for Mental Hygiene, founded by Clifford Beers early in this century. Lately the National Mental Health Foundation was set up by conscientious objectors who worked in United States mental hospitals as an alternative to combat service during World War II.

An effort is currently being made to coordinate the work of these national agencies, together with the activities of a number of state and local mental-hygiene societies. Second national observance of Mental-Health Week, in which all or nearly all participated, was a joint enterprise of the voluntary and official national agencies this year.

In Canada since 1918 the National Committee for Mental Hygiene (now the Canadian Mental Health Association) has been the only national voluntary agency. Until a mental-health division was created in the Department of National Health and Welfare in 1946, the National Committee was the only agency giving leadership on a national scale.

At first the National Committee for Mental Hygiene was a group giving professional consultation, serving governments and institutions with studies and surveys, stimulating research, and fostering the training of promising medical practitioners for specialization. Later it became a multi-disciplinary body. Now, with its expansion into the Canadian Mental Health Association, the "committee" continues its scientific program, but it is also pressing an extension program, the keynote of which is full partnership of the Canadian people. As organization proceeds and program develops, the association may be expected to become very active as an auxiliary to official health agencies.

It is noteworthy that the Department of National Health and Welfare and various provincial governments have welcomed this greater activity by a private agency. An old process has been reversed. Usually voluntary effort has explored and pioneered and official agencies have taken over services of demonstrated value and practicability, whereupon the voluntary groups turn to new areas. In the mental-health field the state has traditionally carried all the responsibility. Now it has been recognized that the task is so formidable, that there is so much that governments cannot now do, or perhaps ever do well, that the interest of well-directed voluntary effort in close liaison with government is highly desirable.

Division of main areas of emphasis and activity will differ from province to province and from community to community. Volunteer programs may be expected to be generally at the pre-clinical level, and in education and mobilization of the public. This does not mean that the voluntary agency pre-empts the educational work, but rather that it will be in a position to strengthen the educational activities of the public-health workers. It is in personal relationships with the people that the health officer and his assisting staff will still have the key role. The task of the health educator in mass techniques, in fostering teacher and nursing training with a mental-health approach, and in various other areas, will still be vital. One can foresee

effective teamwork with official and volunteer health workers combining their skills and resources.

The actual job of informing and motivating the public is full of nuances and perplexities. In the United States the public is being mobilized to support greater expenditures on institutions and clinics. Great emphasis is being given man's historic inhumanity to man. The appeal is definitely emotional, but so far the fear technique has been avoided.

In Canada the problem is being attacked on a wider front. We, too, want to mobilize the people behind our services. We want the people to know about the disgraceful overcrowding of our institutions. Complacency is entirely out of order. So long as in any institution in Canada patients are known as "inmates", who are looked after by "guards"; so long as there is a mental hospital where a patient may exist for 17 years without psychiatric review; so long as our institutions are overcrowded and understaffed; so long as we employ undereducated, undertrained, underpaid personnel, there is great need of improvement, and improvement will be slow indeed without intelligent public interest.

While we are pointing the finger to weaknesses in our institutions we must simultaneously bring to light their strengths, so that we may build up public confidence in them and in the men and women who are devoting their lives to the care and healing of the sick. This, I think, is one of the subtle difficulties that confront the health educator in this area. He must arouse the public to the needs and at the same time do a job of public relations for the very services which are still inadequate.

There is a wider educational job to be done. Perhaps from better understanding of mental-health principles and of the mentally ill will come a public conscience which will not permit the ill to be treated as lawbreakers fully responsible for their actions. Certainly improved treatment facilities should make it no longer permissible to house the mentally ill in jails and lockups pending admission to a hospital.

There is, then, this problem of improved facilities and wider application of psychiatric principles with which those who hope to educate and mobilize the public must be concerned. But our front in Canada does not stop there. We are out to foster mental health. There is a focus on childhood, where there are opportunities for the building of stable, wholesome personalities, and where early emotional problems may be recognized and alleviated. Thus the Department of National Health and Welfare sponsors the now widely used mental-mechanism films in which adult maladjustments are traced to unmet childhood needs, and the child-training folders, in which parents are instructed how they may cope with some problems of parent-child relationships.

The role of the school teacher in developing good emotional resources in pupils is receiving much attention. Therefore provincial educational and health authorities have been selecting qualified teachers for training in mental health; these teachers thereupon are expected to give leadership in education with a mental-health approach. The experimental training of such teachers under joint auspices of the University of Toronto and the Canadian Mental Health Association is passing into its third year. Now that the value and

practicability of such training has been demonstrated, the association is preparing to hand the task to the teacher-training institutions for wider application.

When there is such a shortage of teachers that training standards have had to be lowered, when the teachers' income is below that of most other professional workers, and when so many schools fall far short of acceptable standards for a healthful environment, one cannot expect overnight community concern with the mental-health aspects of school experience. Neither mental-health services nor schools will be what they should and could be until there is an informed, alert public which demands good standards.

The home is still the place where the foundations for good emotional health are laid, and where children can be safeguarded against psychological damage. Parent education, obviously, is an urgent need. There are still many parents who are unaware that children do not live by bread alone. What little parents have learned has been gleaned from popular magazines and from books, often to their confusion.

Public-health workers are interested in parent education, and in their direct contact with many parents the health officer and his staff are uniquely situated to integrate mental-health education with other instruction. The health educator, working with groups rather than individuals, can employ the techniques and skills which are his.

In Canada it has never been sufficiently recognized that the best parent education may be done among people before they become parents, indeed before they marry to found homes. When there is education for marriage and family living in elementary and secondary schools, we shall have more Canadian homes in which the emotional needs of children are met; and, incidentally, we shall have a generation of parents who live more happily with themselves and each other. Introduction of family-life education in Canada is very slow; meanwhile we have about 1,800,000 homes in which children are being raised.

There should be no easy assumption that the inculcation of mental-health principles will be simple. The public is only just beginning to think of mental illness in terms of treatment. It is not aware that mental health, or poor mental health, if you wish, is a matter of degree, and that there are in the community many who are in poor mental health. The public is aware that individuals and groups have problems of behaviour or attitudes, but it does not know them as manifestations of poor health.

The public does not know what psychiatrists mean by mental health. It is not an underestimation of public intelligence to say that the common conception is that people are either well or they are crazy, and the crazy ones are all in institutions or should be.

Even the psychiatrists and their associates have not been able to offer a simple, commonly acceptable definition of mental health. A committee of topflight Canadian public-relations people, seeking a terminology which would express mental-health goals in the language of the man on the street, had several long sessions before it emerged with this: "Mental health is a process, not a static condition; it is growth toward more effective individual and group

living." The committee reflected that it had defined mental health to its own satisfaction but that the definition would have little meaning for the public.

The direct approach to mental health in public education seemed impractical to the public-relations experts, even if a popular definition could be found. "One has to go from the known to the unknown," one expert felt. People know about mental illness and about institutions, even though there may be many misconceptions needing correction. They can be shown that much emotional illness appears to have its roots in experience; and that many of the ills apparent in the community, and the bizarre behavior of individuals and groups have emotional bases. In other words, it is easier to tell people what mental health is not than to tell what it is. That provides a starting point.

It seems extremely difficult, then, to avoid the pathological aspects and talk only of the positive. It seems impossible at this stage of public intelligence to speak intelligibly about mental health without bringing in mental ill health. That is not necessarily bad.

Mental-health education for these reasons is full of tricky subtleties. Fear, obviously, may not be employed. It is not regarded as a legitimate educational technique in any health education. The danger of creating panic should not be forgotten. There must be stimulated public interest and concern without letting it get out of hand. We need first of all to assess public understanding and to ascertain carefully what needs to be done.

In developing mental-health education, the health educator has a vital role. While the subject is the concern of every public-health worker, it is the health-educator who is able to coordinate it. Moreover, he has available the group and mass techniques. He helps with the organization of conferences, institutes and workshops, both those for departmental personnel and those for the public. He helps to find and train leaders, and he drafts resource people. He employs mass media, such as radio and press, literature, films, which serve as outlets of information and motivation. There are a thousand and one methods and techniques which he may use. As a one-time Toronto medical officer of health used to say, "Health education is reiteration, reiteration and reiteration." By this is meant the need to tell the essential facts over and over and in many diverse ways.

There are various community agencies with an interest in mental health, such as parent-teacher groups, councils of social agencies, children's aid societies, and a considerable number of women's organizations. The health educator is his department's liaison officer to such groups. He is often able to give valuable help and to guide programs into the most constructive channels.

In many health departments the health educator is also the liaison officer to other public departments, such as social welfare and education. Introduction of psychiatric principles in the treatment of dependent children, problem families, and the needs of the aged and the crippled may be stimulated. Application of mental-health principles in teacher training is vitally important.

Because of his wide range of skills and his experience, and because of his relationships within the government and in the community, the health educator

occupies a key position. Upon his ability to interpret and to win public goodwill, upon his tact and his enthusiasm much will depend if adverse economic conditions bring demands for curtailment of public spending.

Through it all, the wise health educator will not forget that a good leader pushes others forward while pulling himself back. He will consider himself and his division as auxiliary to those directly in charge of mental-health advancement, and he will regard his associates in public health, the health officer and his staff, as having the primary opportunities and responsibilities. He will retain a necessary humility, remembering always that the public whom he serves has the final say. Without public understanding and without public participation, a mental-health program cannot go far; with these, the potentialities are immeasurable.

REFERENCE

Ethel L. Ginsburg, "Public Health is People." New York: The Commonwealth Fund, 1949.

"SAMPLING TECHNIQUES: THEIR APPLICATION TO SICKNESS SURVEYS"

The JOURNAL regrets that the references for the article by Mr. D. K. Dale, "Sampling Techniques: Their Application to Sickness Surveys", could not be published in the December issue. They are included in the reprints of the article, copies of which are available from the author or from the Association.

Further Observations on the Production of Diphtheria Toxin in Shake Cultures by C. diphtheriae

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IT has been reported by Linggood and Fenton (1947), Woodward, Tallman, and Perrotta (1948), and Cordova-Marquez (1948) that *C. diphtheriae* produces a potent toxin when grown in suitable media under submerged conditions by means of shake cultures. In view of the fact that the present routine production method involves considerable labor and is time-consuming, the study here reported has been approached as a development problem with the objective of more economical toxin production.

Method

The present routine production of diphtheria toxin in these laboratories employs *C. diphtheriae*, Park Williams strain No. 8 in modified Mueller's basic medium fortified with 2.2 per cent proteose peptone. The toxin is produced statically in Fernbach flasks with each flask containing 300 ml. of medium at a depth of approximately 1 cm. Incubation is at 34° C. for a period of 6 days, with a final yield which averages 50–67 Lf per ml.

The same type of flasks and medium were used in producing toxin under submerged conditions, in three to five times the usual volume with 40–48 hours of incubation.

Inoculation of Culture

Flasks containing 300 ml., 600 ml., 900 ml., 1200 ml., and 1500 ml. of medium at depths of approximately 1, 2, 3, 5, and 7 cm., respectively were inoculated with a loopful of a 24-hour surface culture pellicle and incubated at 37° C. on a shaking machine. The shaker rotated at the rate of approximately 110 cycles per minute. The organism grew rapidly and it was only a matter of hours before the medium was very turbid. No antifoam agent was necessary.

Each flask was sampled aseptically at 24, 30, 36, 40, and 48 hour intervals. The samples were examined by microscope for purity. They were then centrifuged, the supernatant tested for Lf concentration, and the pH was determined by glass electrode. Figure 1 illustrates graphically the relationship between Lf and time in hours and days, and shows the comparison of Lf yield between submerged growth and surface growth. The abscissa represents time in hours

and days and the ordinate represents toxin units designated by Lf/ml. It can be noted that in all cases of submerged growth the Lf reached its peak in 48 hours or less. In 300 ml., an Lf of 65 units/ml. was obtained in 40 hours; in 600 ml., an Lf of 60 units was obtained in 48 hours; in 900 ml., an Lf of 53 units was obtained in 48 hours; in 1200 ml., an Lf of 52 units was obtained in 48 hours; and in 1500 ml. an Lf of 42 units was obtained in 48 hours.

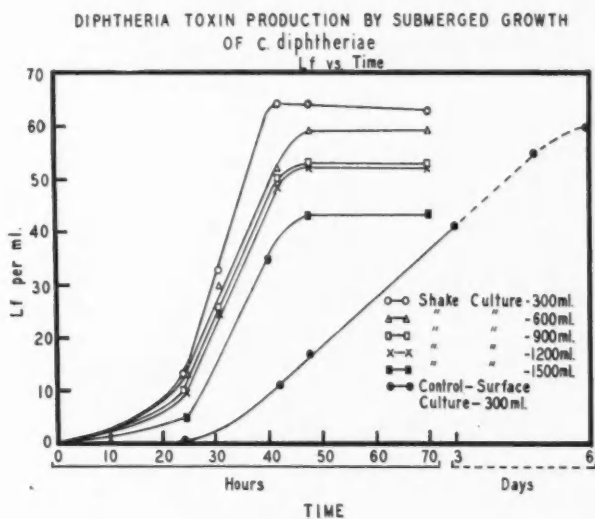


FIGURE I

Some of the same medium was used for the production of toxin by the routine surface growth incubated as usual at 34° C. This toxin averaged an Lf of 58 units per ml. in 6 days, and is referred to hereafter as "control toxin".

Figure II illustrates the pH behavior during the toxin-producing period. According to Mueller (1941) there should be little change in the pH of the medium with the optimum concentration of maltose. The conditions for growth and toxin-production therefore remain fairly constant due presumably to the liberation of ammonia or other basic materials from some of the amino acids. Also there is a gradual formation of CO₂ and other acids from the apparently completely oxidized maltose.

Potency Tests (Lf, L+, MLD)

Lf values were determined by the flocculation method of Ramon, 1922; Glenny and Okell, 1924. The MLD and L+ were tested by the required method of the National Institute of Health. The two toxins are alike in so far as guinea-pig potency tests are concerned. The submerged toxin contained 3000-4000 MLD per ml. with an L+ dose of 0.02 ml. (50 L+/ml.), while the control toxin ranged from 2000-3000 MLD with an L+ dose of 0.02 ml.

Detoxification

Following the termination of the incubation period, the toxic broth was filtered with the aid of standard supercel and 0.45 per cent formalin was added. It was then filtered through a 13-lb. bacteriological filter candle and stored at 37° C. for a period of 30 days. Samples were taken at the end of 14, 17, 21, 24, and 30 days and tested in guinea pigs for toxicity. These tests were

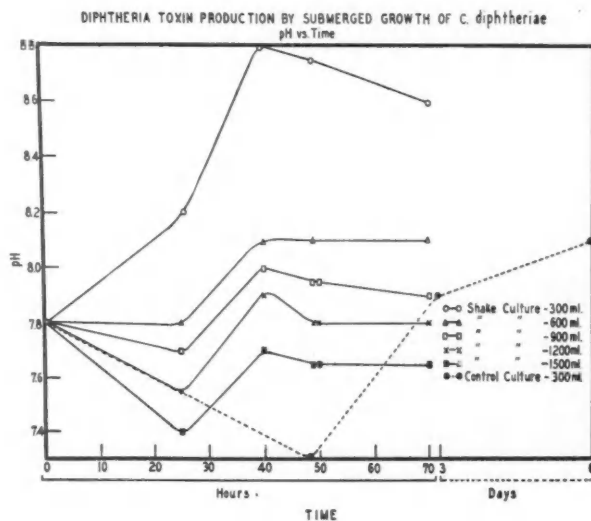


FIGURE II

carried out in accordance with the National Institute of Health requirements for detoxification test; i.e., four guinea pigs weighing between 300 and 400 g. each must survive 5 ml. of toxoid injected subcutaneously and show no signs of diphtheria poisoning during 30 days.

Thirty days is the minimum time required to completely detoxify toxin produced by the routine surface-growth method. It appeared that 21 days was sufficient for complete detoxification of the submerged-growth toxin since the guinea pigs injected with material that had been detoxified 21 days showed no signs of diphtheria poisoning. The explanation may be that in the case of the submerged-growth toxin there is a shorter incubation period and therefore less time for cell autolysis. Hence, the formaldehyde may be more effective in neutralizing the toxic properties that are present and a more rapid detoxification takes place. There is probably greater cell autolysis which takes place in the surface-culture growth, due to the longer incubation period and therefore more non-specific material to combine with and bind the formaldehyde. The nitrogen contents of the two toxins were approximately the same. In the case of the surface-culture toxin an average of 3.59 mg./ml. were present as against an average of 3.75 mg./ml. in the submerged-culture toxin. But despite the similarity in nitrogen, the submerged-culture toxin was detoxified

more rapidly since 30 days were required to detoxify the surface-culture toxin under the same conditions.

Antigenicity—Fluid Toxoid

Following the detoxification of the submerged-culture toxin, with the formation of toxoid, the material was tested for antigenicity in guinea pigs by the usual method of the National Institute of Health. The results of these tests showed 100 per cent protection following immunization with 0.5 ml. when challenged with 10 MLD of toxin at the end of 6 weeks. The control toxoid also gave similar protection.

Alum Precipitation

Routinely in these laboratories, fluid diphtheria toxoid is alum-precipitated with aseptic technique in the following manner. To the sterile fluid toxoid is added, with constant agitation, 1.75 per cent by volume of an 8 per cent sterile potassium alum solution and the pH adjusted to 4.8–5.0. The precipitated toxoid is allowed to settle overnight and washed once each day for three successive days with sterile 0.85 per cent sodium chloride solution. Preservative is added and the material is tested for antigenicity.

The toxoid derived from the submerged culture toxin did not yield as satisfactory an alum precipitate as the control under the above conditions. Instead of pH 4.8–5.0, it was necessary to raise the pH of the submerged-culture toxin to 6.8–7.0. At the lower pH little or no settling of the precipitated toxoid was visible. Only at the higher pH was there a settling of the precipitate so that washing was possible. The final pH of the finished product remained near neutrality, which seems more desirable than an acid pH.

The National Institute of Health requires that the finished toxoid shall contain not more than 15 mg. of alum in any individual human injection as determined by analysis. Alum analysis of the toxoids derived from the submerged-culture toxin results in 6.2–6.8 mg. alum per human injection (0.5 ml.). The control toxoid analysis was also 6.2–6.8 mg.

Free Formaldehyde Content

The National Institute of Health requires that not more than 0.02 per cent of free formaldehyde shall be present in the final product as determined by analysis. The free formaldehyde which remained in the final alum toxoids derived from the submerged-culture toxins ranged from 0.001 per cent to 0.003 per cent. The control toxoid analysis was also 0.001 to 0.003 per cent.

Antigenicity of Alum-Precipitated Toxoid

The final precipitated toxoid was then tested for antigenicity by the required method of the National Institute of Health. For this material this involved injecting 0.5 ml. doses subcutaneously into guinea pigs weighing 450–550 g. each. There must be produced at least 2 units of antitoxin per ml. of serum in not more than 4 weeks in an aliquot serum-pool from not less than 4 guinea pigs. The three alum-precipitated toxoids which were tested resulted

in 4, 6, and 6 units antitoxin per ml. serum. The Lf of the alum toxoids was 31, 40, and 43 units per ml., respectively.

SUMMARY

A more rapid method of producing diphtheria toxin in modified Mueller's basic medium fortified with 2.2 per cent proteose peptone has been described. Instead of the usual surface-culture method, which is more time-consuming and laborious, the Park Williams No. 8 strain of *C. diphtheriae* was grown in larger volumes of medium under submerged conditions in shake cultures and produced toxin which is at least the equal of or superior to that toxin produced by surface cultures. The Lf of the surface-culture toxins varied from 50-65 units per ml. after six days' incubation at 34° C., and in submerged-culture toxins the Lf production ranged from 50-65 units per ml. after forty-eight hours' incubation at 37° C.

Interesting features of the submerged-culture toxin are (1) that it can be detoxified, with the formation of toxoid, more rapidly than the surface-culture toxin; (2) it must be alum-precipitated at pH 6.8-7.0 rather than the routine pH of 4.8-7.0; (3) its final alum and free formaldehyde content easily meet the minimum requirements of the National Institute of Health; (4) the alum-precipitated toxoid gives a good antigenic response as indicated by the guinea-pig test; and (5) from the standpoint of economical production, it appears that it is more important to produce the maximum total Lf per flask by using larger volumes despite the fact that the Lf per ml. may be less than in the case of surface cultures under ideal volume conditions. For example, 300 ml. of medium yields an Lf of 65 units per ml. or a total of 19,500 Lf units, whereas 1500 ml. of medium yields an Lf of 42 units per ml. or a total of 63,000 Lf units. This is a three- to four-fold increase and would seem advisable, especially if the fluid toxoid is to be concentrated and refined by any current means.

A similar set of results was obtained when the process as previously described was performed under identical submerged conditions, except for a variation in temperature from 37° C. to 34° C.

ACKNOWLEDGMENT

The assistance of Dr. G. F. Leonard and Mr. G. S. Reed of the Squibb Bacteriological Control Laboratories in their performance of the animal tests is gratefully acknowledged.

REFERENCES

1. Cordova-Marquez, R.: The Effect on Toxin Production of Passing Air and CO₂ through Deep Broth Cultures of *C. diphtheriae*. Proceedings, Soc. Am. Bact., 1948, 1: 10.
2. Federal Security Agency, National Institute of Health, Bethesda, Maryland: Minimum Requirements for Diphtheria Toxoid. (4th revision, March 1, 1947.)
3. Glenny, A. T. and Okell, C. C.: The Titration of Diphtheria Toxin and Antitoxin by Flocculation Methods. J. Path. & Bact., 1924, 27: 187.
4. Linggood, F. V. and Fenton, E. L.: The Production of Diphtheria Toxin by Submerged Culture in Shaking Flasks. Brit. J. Exper. Path., 1947, 28: 354.
5. Mueller, J. H.: A Simplified Formula for Diphtheria Toxin Broth. J. Immunol., 1929, 37: 103.
6. Mueller, J. H. and Miller, P. A.: Production of Diphtheria Toxin of High Potency (100 Lf) on a Reproducible Medium. J. Immunol., 1941, 40: 21.
7. Ramon, G.: Comp. rend. Soc. Biol. (Paris), 1922, 86: 661.
8. Woodward, C. R., Jr., Tallman, A. W. and Perrotta, J.: Production of Diphtheria Toxin by Submerged Cultures of *C. diphtheriae*. Proceedings, Soc. Am. Bact., 1948, 1: 9.

ABSTRACTS OF PAPERS PRESENTED AT THE EIGHTEENTH
ANNUAL CHRISTMAS MEETING OF THE LABORATORY SECTION,
CANADIAN PUBLIC HEALTH ASSOCIATION,
CHATEAU LAURIER, OTTAWA,
DECEMBER 18-19, 1950

**Bacterial Examination of Blowflies (*Lucilia* sp.) and Houseflies (*Musca domestica*) Which
During Their Larval Stage Had Fed on Chicks Infected with *Salmonella pullorum*.**

RONALD GWATKIN and LUCIJA DZENIS, Division of Animal Pathology, Science Service, Dominion Department of Agriculture, Animal Diseases Research Institute, Hull, P.Q.

The eggs of blowflies and houseflies were hatched on chicks which had died of pullorum disease and in which *Salmonella pullorum* had been demonstrated by cultural methods. The larvae fed on this material and emerged to pupate in clean sand. When flies hatched, 513 blowflies, 30 larvae, and 8 pupae were crushed and planted in broth which was plated 24 hours later on brilliant green agar. One hundred and ten newly hatched houseflies and 20 larvae were examined in the same way. None of these specimens yielded *S. pullorum* on culture but it was isolated from the original flies after being in contact with the infected chicks.

The Effect of Adrenocorticotrophin (ACTH) on Circulating Antibody Levels.

JOAN A. deVRIES, Department of Bacteriology and Immunology, McGill University, Montreal, P.Q.

Previously immunized subjects were given large doses of ACTH in an attempt to bring about the release of preformed antibody from tissue cells which might have been storing it. The cytoplasm of lymphocytes has been suggested by some authors to contain immune globulin.

Human subjects immunized with staphylococcal toxoid and rabbits immunized with crystalline egg albumen were used.

Stimulation of the adrenal cortex by ACTH produced an increased plasma volume, increased serum proteins, and a lymphopenia, but no rise in the circulating antibody level. On the contrary, there was a depression of antibody titres. This decrease could not be explained on the basis of blood dilution alone.

**The Effect of the Protein Level of the Diet and of Liver Damage on the Complement
Titre and Coagulation Activity of the Blood.**

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Adult guinea-pigs maintained on a basic diet of oat hulls, containing 3.5 per cent protein, supplemented by vitamins, showed a considerable drop in weight over a six-week period. Their complement titres were depressed, the prothrombin time values for their plasma prolonged, and the total protein and albumin content of their serum lower than in groups of animals given the same basic diet plus 15 or 25 per cent purified casein. Even greater changes were observed in guinea-pigs injected repeatedly with small amounts of carbon tetrachloride. The decline in complement titre (all major complement components were affected) and prothrombin values appeared to parallel the distribution and degree of fatty degeneration in the liver. The effect of the liver damage on protein manufacture was shown by the reduction in serum albumin and in albumin-globulin ratio (from a mean value of 1.35 to a mean value of 1.02). No significant change in total serum globulin was detected, but the fact that the first and second components of complement and prothrombin, all of which are globulins, were decreased, indicated that the globulin as well as the albumin metabolism had been affected.

On the whole, therefore, reduction in protein intake and in protein manufacture had a roughly parallel effect upon the complement titre and coagulation time of the blood of these groups of guinea-pigs.

Studies of the Effect of Botulinum Toxin upon the Bacterial Acetylation of Choline.

J. W. STEVENSON, Department of Bacteriology and Immunology, McGill University, Montreal, P.Q.

The toxin of *Cl. botulinum* (type A) exerts its effect at the myoneural junctions of cholinergic nerves where it would appear to inhibit either the synthesis of acetylcholine or the release of acetylcholine. The microbiological synthesis of acetylcholine by *Lactobacillus plantarum* involves a mechanism of acetylation of choline identical to that of mammalian cells. A series of studies have been carried out to determine the effect of the toxin upon the microbial acetylation of choline. This system has a distinct advantage in that one can conveniently study the influence of the toxin upon the synthesis of acetylcholine by intact living cells under natural conditions.

In the course of the investigation, it has been shown that botulinum toxin does not inhibit (i) the synthesis and secretion of "free" acetylcholine by actively proliferating lactobacilli in culture, (ii) the synthesis and storage of "bound" acetylcholine by actively proliferating lactobacilli in culture, and (iii) the synthesis and secretion of acetylcholine by living but non-proliferating bacterial cells incubated in a suitable chemically defined substrate.

Plague Infection in Western Canada. Information gleaned from rodent surveys, 1938-1950 (incl.).

F. A. HUMPHREYS, A. G. CAMPBELL and E. S. SMITH, Laboratory of Hygiene, Department of National Health and Welfare, Kamloops, B.C.

Plague surveys have been carried out in Western Canada since 1938. These have revealed the presence of plague in ground squirrels (*Citellus richardsonii*) in southeastern Alberta and southwestern Saskatchewan and in marmots (*Marmota flaviventris*) in the southern interior of British Columbia. Intensive surveys of the British Columbia littoral have so far failed to reveal any evidence of plague in domestic rats. Ground squirrels harbour an average of 2.5 fleas per animal, marmots 34, and rats, rarely heavily infested, average only 0.61.

A total of 5,019 tissue specimens and 4,641 flea pools (136,135 fleas) taken from 71,254 rodents have been examined. *Pasteurella pestis* was recovered from 11 of the tissue specimens and from 51 of the flea pools. In only three instances where the tissues were positive were the corresponding fleas negative. In two of these, only one flea per animal had been found. The findings suggest that, except where rodents are relatively free of fleas, routine tissue examinations are unnecessary. Cyanogas has proved definitely superior to chloroform as a pulicidal agent for the collecting of ectoparasites.

Studies on Vitamin B₁₂ Production by Micro-organisms.

MARGARET BURTON, Division of Bacteriology and Dairy Research, Science Service, Department of Agriculture, Ottawa, Ontario.

Over 60 per cent of the bacteria and actinomycetes isolated from soils, manure, seed washings, and poultry-house litter were able to synthesize vitamin B₁₂ as determined by the *Lactobacillus lactis* plate cup assay. Some noteworthy discrepancies were found between the plate assay employing the test organism *L. lactis* and a titration method using *Lactobacillus leichmannii*. More detailed studies were made of isolates showing B₁₂ yield of at least .15 γ per ml. of metabolic solution by the *L. leichmannii* assay. Factors studied included media, reaction, aeration, and inoculum.

Results Obtained with a Glycerolized Vi Antigen in the Detection of Typhoid Carriers.

MAURICE SAINT-MARTIN and J. M. DESRANLEAU, Division of Laboratories, Ministry of Health, Montreal, P.Q.

A rapid slide agglutination test, using a glycerolyzed Vi antigen from Bhatnagar Vi I strain, is described in detail. Results obtained on 10,912 sera from October, 1946, to August, 1950, showed that this reaction offers sufficient sensitivity and specificity to warrant its use as a routine procedure in a public health laboratory. Negative results were obtained in 98.8 per cent of normal sera and in 98.2 per cent of sera from vaccinated

individuals. In 80 (15 per cent) of 530 clinical cases of typhoid, a positive Vi reaction was observed. Twenty-six bacteriologically proven carriers had Vi antibodies in their sera. This serological procedure is believed to be an efficient screening procedure which should be supplemented, if positive, by the isolation of *S. typhi* from faeces, urine, or duodenal juice.

The Effect of pH on the Agglutination of *Salmonella typhosa* in Human and Rabbit Antisera.

W. R. A. BAILEY, Laboratory of Hygiene, Department of National Health and Welfare, Ottawa, Ontario.

Techniques used in the performance of routine Widal tests vary widely and thus cause considerable variation in the results obtained. Standardization of the test and its reagents is highly desirable. The effect of pH on the agglutination of *Salmonella typhosa* is one of many variables, as is shown in this study.

The standard strains H901 and O901 were employed in preparing H and O suspensions in buffered solutions ranging from pH 5.0-8.0. Agglutination of these suspensions in human and rabbit antisera is recorded.

The optimum range of pH for agglutination in rabbit antisera was pH 6.3-7.7 and in human sera pH 6.1-6.8. In the rabbit antisera, there was a marked progressive depression of agglutination below pH 6.3, while above pH 7.7 depression was slight. Depression of agglutination was progressive in human sera from active cases of typhoid above and below the optimum level pH 6.1-6.8. In the sera from immunized persons, agglutination was noticeably depressed only in the range pH 6.8-7.4.

The Use of CAMP Test (a Lytic Phenomenon Exhibited by Group B Streptococci) for the Rapid Identification of *Streptococcus agalactiae*.

D. A. BARNUM, Associate Professor, Department of Preventive Medicine and Hygiene, Ontario Veterinary College, Guelph, Ontario.

Christie, Atkins and Munch-Petersen, in 1944, first reported on the lytic phenomenon shown by the interaction of Group B streptococcus and staphylococcal beta toxin. In further reports they suggested its use as a test for the identification of *Streptococcus agalactiae*.

This report concerns the application of this phenomenon as a diagnostic aid in a mastitis control laboratory where the rapid identification of *Streptococcus agalactiae* is required. In routine work, the use of the staphylococcus streak plate was found more satisfactory than the direct application of the beta toxin. The blood used in the preparation of the media for such a test must be from an animal whose serum contains little or no beta antitoxin. No explanation for this phenomenon is offered.

A Rapid Phage-Plaque Count Technique for the Detection of Specific Organisms in Mixed Populations.

H. KATZNELSON, Division of Bacteriology and Dairy Research, Science Service, Department of Agriculture, Ottawa, Ontario.

The use of specific phages for identifying or typing bacterial species or strains normally involves isolation of the organism followed by phage-testing. The first step may be a time-consuming process, depending on the organism concerned and the microbiological population of the material from which it is to be isolated.

A method is proposed which eliminates the need for isolation. It consists of adding a known number of phage particles to a sample suspected of harboring the homologous bacterial species or strain and making plaque counts at the time of mixing and at any arbitrarily selected time afterwards. A significant increase in number of particles is considered to indicate the presence of the homologous bacterial cells in the sample. The presence of unrelated contaminants does not usually obscure the plaques and the use of suitable inhibitors, selective media for plaque-count and a heavy suspension of host cells in the plates used for plaque counts, will reduce the numbers of these contaminating organisms. Specific phages are essential. The occurrence of resistant strains may result in false negatives but this may be overcome by the use of a composite phage stock obtained by pooling phages for the organism isolated from different sources. The method has been applied successfully.

The Action of Certain Oxidizing Agents on Viral Antigens.

J. R. POLLEY, ANNE GILLEN and MURIEL BURR, Laboratory of Hygiene, Department of National Health and Welfare, Ottawa, Ontario.

The ability of various oxidizing agents to destroy the infectivity of influenza virus has been investigated. As a result of this study, a method has been developed for the preparation of an antigen for the laboratory diagnosis of influenza which is stable on storage and is non-infective.

Recent Work in Incorporation of P_{32} in Bacteriophage.

S. M. LESLEY, R. C. P. FRENCH and A. F. GRAHAM, Connaught Medical Research Laboratories, University of Toronto, Toronto, Ontario.

T2r+ bacteriophage grown in its host, *E. coli*, strain B, in broth medium in the presence of radioactive inorganic phosphorus (P_{32}), was labelled with the isotope. Highly purified preparations of this virus had specific activities up to 50,000 counts per minute per microgram of phosphorus. There was no significant exchange of P_{32} between virus and inorganic phosphate. Chemical analysis showed that 99 per cent of the radioactivity of the labelled bacteriophage was contained in the nucleic acid fraction. The amount of P_{32} incorporated into the structure of the bacteriophage particles was sufficient for metabolism studies to be made on the growth of the labelled virus in the host cell.

The Effect of Combinations of Antibiotics on *Pseudomonas aeruginosa* and on *Proteus vulgaris*, *in vitro* and *in vivo*.

C. W. J. ARMSTRONG and A. E. LARNER, Laboratory of Hygiene, Department of National Health and Welfare, Ottawa, Ontario.

To date, infections due to these two species have been relatively resistant to antibiotic therapy. Individual sensitivities of seven strains of *Ps. aeruginosa* and of four strains of *Pr. vulgaris* to the five antibiotics—Aureomycin, Chloromycetin, Penicillin, Dihydrostreptomycin, and Terramycin—were determined in terms of bactericidal concentrations. The drugs were used singly, in pairs, and three at a time. Certain combinations were outstanding for the marked reduction in bactericidal concentrations of each of two or more drugs used simultaneously as compared to their lethal concentrations when used one at a time.

Mice infected with a mixed culture of the several strains of one or other species were treated by intraperitoneal injection of those drug combinations indicated by the *in vitro* experiments to be more promising. In a high proportion of cases, it has been possible to duplicate the more favourable *in vitro* results with *in vivo* experiments. The clinical significance of these findings is discussed.

Effect of BCG Vaccination and of Chemotherapy in Experimental Murine Tuberculosis.

CHARLES O. SIEBENMANN, Connaught Medical Research Laboratories, University of Toronto, Toronto, Ontario.

Experimental data are presented which show that for the study of the effect of vaccines and chemotherapeutic agents on experimental tuberculosis in mice, microscopic counts of acid-fast bacilli in lung, liver, and spleen may provide valuable quantitative information. Such counts can be made in stained sections or contact films prepared from the freshly cut organs. By means of this technique it can be shown that with intravenously infected mice:

- (1) Chemotherapy (streptomycin plus PAS) is more effective in the lungs than in the other two organs.
- (2) BCG vaccination has a suppressive action upon the tuberculous infection, leading to markedly reduced counts of acid-fast bacilli in lung, liver, and spleen.
- (3) BCG vaccination is as effective against a streptomycin-resistant strain of *M. tuberculosis* as it is against a streptomycin-sensitive culture.

The counting technique, which is applicable in the case of mice only, is proposed as a supplementary measure to be used in conjunction with methods based on the determination of rates of survival and the recording of histo-pathological changes. It provides most useful information when applied to experiments in which all treated mice survive the test period.

Observations *in vitro* on the Adaptation of *Mycobacterium tuberculosis* to Streptomycin and Chemotherapeutic Agents.

A. JOSIUKAS, T. E. ROY and GLADYS BOYD, Department of Bacteriology and the Department of Pediatrics, Hospital for Sick Children, Toronto, Ontario.

Attempts have been made *in vitro* to determine the ease and rapidity with which recently isolated strains of *Mycobacterium tuberculosis* will develop resistance to drugs by

passage on media containing these drugs. Streptomycin (STR), para-aminosalicylic acid (PAS), para-acetylaminobenzaldehyde thiosemicarbazone (TB1), and a combination of STR and PAS were used. Passage and sensitivity tests were done on Herrold's egg-yolk agar.

Passage of 40 strains of normal sensitivity (inhibition by 1.6 to 6.4 micrograms per cc.) on STR showed a moderately fast development of resistance so that after the sixth passage all grew in streptomycin concentrations of 100 to 1000 micrograms per cc. A similar passage of 40 strains on PAS media showed a slow development of resistance, and after the sixth passage many strains remained fully sensitive to PAS concentrations of 0.4 to 1.6 micrograms per cc. Passage of 10 strains on TB1 showed a fast development of resistance, so that all were resistant to 100 micrograms per cc. of TB1 at the second or third passage. Following six passages of 40 initially sensitive strains on media containing combined STR and PAS there was a moderate increase in resistance to STR in some strains, little increase to PAS, and no increase to the combined STR and PAS. Six passages of 6 streptomycin-resistant strains on a combination of STR and PAS yielded results comparable to passage on PAS alone, and there was no increase in streptomycin sensitivity in the strains.

Bacterial Death Rate Studies with Quaternary Ammonium Disinfectants.

C. E. CHAPLIN, Division of Bacteriology and Dairy Research, Science Service, Department of Agriculture, Ottawa, Ontario.

Death rate studies on bacteria under the influence of quaternary ammonium disinfectants revealed that the survivor curves are sigmoid. The shape of the curves is attributed to a wide difference in the resistance of the individual cells to the action of the disinfectants.

By treating a suspension of test organisms with a dilution of quaternary, the more susceptible portion of the population was eliminated, leaving a relatively resistant strain. This strain showed a logarithmic order of death with the same disinfectants that produced a sigmoid survivor curve with the parent strain.

Aerobiological Sampling Methods from Aircraft.

C. D. KELLY, Department of Bacteriology and Immunology, McGill University, Montreal, P.Q.

In the study of numbers and types of bacteria and fungi in the outer air, especially when samples are taken from aircraft, certain difficulties are encountered. The most important of these are due to the small number of organisms present in the air, which makes it necessary to take large samples, and to the diversity of types, making it difficult to select a suitable medium, especially when using agar plates.

Three sampling methods are discussed which have been used for sampling air from aircraft:

1. A method using the General Electric Bacterial Air-Sampler.
2. Adaptation of the Slit-Sampler for use in aircraft.
3. A glass-wool filter system.

A Report on an Outbreak of Food Poisoning Associated with Milk from Cows Harboring *Staphylococcus pyogenes*.

D. A. BARNUM and N. A. FISH, Department of Preventive Medicine and Hygiene, Ontario Veterinary College, Guelph, Ontario.

Outbreaks of staphylococcal food poisoning involving two rural families are reported. A series of attacks occurred over a period of months and were always associated with the consumption of a fresh-cream lettuce dressing. The cream was secured from the milk of the animals in the farm dairy herds. Herd examinations revealed that three cows in one herd and one in the other were suffering from chronic mastitis. The infecting organisms from these cases were strains of *Micrococcus pyogenes* var. *aureus* which were capable of producing an enterotoxin.

The most favourable conditions for the production of the toxin in the milk (before removal of the cream) were improper cooling and storage. The importance of this fact is shown by an apparent relationship of the outbreak to climatic conditions.

Severe Infections Due to Organism B 5 W (*Bacterium anitratum*).

T. E. ROY, GRACE CRAIG and NELLES SILVERTHORNE, Department of Bacteriology and Department of Pediatrics, Hospital for Sick Children, Toronto, Ontario.

Severe infections due to organism B5W (*Bacterium anitratum*) appear to be infrequent. Two cases of septicaemia and three cases of meningitis have been seen. Two of the latter were fatal. The three meningitis cases were of particular interest because they came from the same nursery at the same period of time. The microorganisms may be mistaken easily for meningococci in direct smears from body fluids or liquid culture media, but they show some unusual morphological features in proper cultures. They resemble the *Enterobacteriaceae* in most cultural characters. There are differences between strains in their susceptibility to antibiotics.

Report on a Fatal Case of Nocardiosis.

A. M. MASSON, Department of Bacteriology and Immunology, McGill University, Montreal, P.Q.

A 10-year-old boy who had been sick from early infancy and hospitalized on several occasions in various places in England and the United States was admitted to the Royal Victoria Hospital, Montreal, for a subacute bronchopneumonia of unknown etiology.

He developed symptoms of empyema while on a course of ACTH combined with antibiotic therapy. Pus from a lung abscess, obtained by puncture, showed gram-positive filaments on smear and cultures grew on an organism identified as *Nocardia asteroides*.

The child died a few days later and autopsy revealed generalized granulomatous lesions similar to those seen in miliary tuberculosis but of a definite yellow colour. *Nocardia asteroides* was isolated from lesions of the liver, the spleen, the lung, and a mesenteric lymph node.

The strain is described and the role of ACTH in the spreading of lesions put forward for discussion.

The Isolation of *Listeria monocytogenes* from Animal Species in Ontario.

A. F. BAIN, Department of Preventive Medicine and Hygiene, Ontario Veterinary College, Guelph, Ontario.

Reports on the isolation of *Listeria monocytogenes* from animal species in Canada are few, particularly compared to the large number of isolations reported in the United States. The organism has been isolated on three occasions within the past year, from animals, at the Ontario Veterinary College. The first isolation was from a case in a cow. The second isolation was from chinchilla, and appears to be the first isolation of the organism from this species. The third isolation was from a sheep brain received early in June which had proved negative on culture at that time. The history and the examination of sections indicated that the condition was listerellosis. Using a technique and a medium described by Gray et al., repeated cultures of refrigerated brain suspension resulted in the isolation of the organism in late August.

The Haemagglutinins of Vaccinia Virus.

ANNE GILLEN, MURIEL BURR and F. P. NAGLER, Laboratory of Hygiene, Department of National Health and Welfare, Ottawa, Ontario.

Studies have been carried out on two haemagglutinins recovered from vaccinia-virus infected chorioallantoic membranes. These are separable by high-speed centrifugation. The smaller heat-labile fraction is Seitz-filterable. The larger heat-stable fraction is more closely related to the elementary body.

A Cytological Study of Phage-Infected Bacteria.

R. G. E. MURRAY, Faculty of Medicine, University of Western Ontario, London, Ontario.

The phages used were some acting on *Escherichia coli* B (T-phages), *Shigella sonnei* and *Bacillus cereus*. Samples of infected cells were taken at closely timed intervals and fixed suitably for the HCl-Giemsa, Feulgen, thionin, and other cytological procedures.

Cytological changes, particularly in the nuclear apparatus, appear very rapidly after a cell is infected with bacteriophage. The precise form of alteration is a characteristic of the phage and not of the host strain. There is an orderly progression of changes in chromatin arrangement throughout the latent period. Multiple infection of the cell, either with a single kind of phage (e.g. T2+, giving lysis inhibition) or with two closely related phages (e.g. *Bacillus cereus* phages) caused some modification of the events seen in single infection.

Under equivalent conditions, the experiments were remarkably reproducible. In the case of T2 phage infection the sequence of events could be correlated with the published biochemical studies.

The observations are discussed, and attention is drawn, in particular, to the cautions that must be observed in the interpretation of electron microscope studies of phage reproduction.

Two Cases of Rat-Bite Fever due to *Streptobacillus moniliformis*.

C. E. DOLMAN, DONNA E. KERR, HELEN CHANG and A. R. SHEARER, Division of Laboratories, Provincial Department of Health, and Connaught Medical Research Laboratories (Western Division), University of British Columbia, Vancouver.

Two cases are described of febrile illness following rat bites on the fingers of female Indian children, aged 12 months and 3 years respectively. *Streptobacillus moniliformis* was isolated by blood culture from both patients on several occasions, while 10 weeks after they had been bitten, a pleuropneumonia-like organism was obtained in place of the streptobacillus. Although clinically the cases were mild, their bacteraemic states persisted despite the successive administration of large doses of penicillin, aureomycin, and streptomycin. The *in vivo* resistance of this particular strain of streptobacillus to penicillin was confirmed by *in vitro* tests, and is at variance with the reports of other workers who have found *Streptobacillus moniliformis* to be quite susceptible to penicillin. These discrepant findings are probably due to the special liability of our strain of streptobacillus to undergo transformation to a penicillin-resistant pleuropneumonia-like variant.

In the laboratory, considerable confusion arose from pseudo-spirochaetal artefacts of erythrocytic origin, which were mistaken for *Spirillum minus*. The thesis is submitted that the streptobacillus is the main, if not the exclusive cause of the rat-bite fever syndrome in man; and that the role of the spirillum is subordinate, perhaps negligible, and at any rate unproven.

***Streptobacillus moniliformis* and Its Pleuropneumonia-like Variant.**

C. E. DOLMAN and HELEN CHANG, Connaught Medical Research Laboratories (Western Division), University of British Columbia, and Department of Bacteriology and Preventive Medicine, University of British Columbia, Vancouver.

The nature of the relationship between *Streptobacillus moniliformis* and the pleuropneumonia-like organism often associated with it, has for some years been controversial. Klieneberger-Nobel, the chief protagonist of the contention that these micro-organisms were symbionts, has recently conceded that her hypothesis is no longer tenable, and that the bacillary forms and her so-called L-forms are "two different generations of the same organism". Evidence is here presented, based on our own experience of a reversible streptobacillary-"L" transformation, which gives further support to the variant theory.

Canadian Journal of Public Health

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PUBLIC HEALTH PRACTICE IN CANADA

A FEW months ago the Association issued the report* of the Study Committee on Public Health Practice in Canada, a project made possible through the generous support of the W. K. Kellogg Foundation. The study relates primarily to the public health practice of the physician and the nurse in official public health agencies and the bearing that these practices have on the recruitment and maintenance of public health staffs. The report, which has been widely circulated, is based on the findings of a survey of urban and rural areas in all the Provinces of Canada during 1947-48. The field studies occupied the major part of a year, and the work was ably done by Dr. J. H. Baillie and Miss Lyle Creelman. A representative committee, under the chairmanship of Dr. J. S. Kitching, studied the findings, and the report with its recommendations presents their considered opinion.

Official public health work in Canada faces many serious problems—not only those to be dealt with in the field but also the equally serious problems within the public health organization itself. The report of the study committee should be considered by every public health administrator in Canada. Like all reports, it may be read and the recommendations approved; yet little will be accomplished if it does not lead to action. In the belief that the problems presented in the report call for much thought, it is planned to publish sections of it in the Journal from time to time during the coming months.

The introduction to the report states:

Present public health services at the local level should be subject to careful scrutiny, and an attempt made to create some degree of uniformity in public health practice across Canada. Before this can be done, there must be agreement on and implementation of services which may be deemed desirable, with rejection of certain undesirable features. . . .

In far too many cases, official agency programs are purely routine as a result of provincial policy, local precedent, or both. The ambitious public health worker is unable to derive adequate job satisfaction from working in a groove, and he is apt to lose initiative

*A limited number of copies of the report are available without charge from the Association's office.

or else leave for other agency positions which he feels will provide better scope for his abilities. For job satisfaction there must be freedom to explore, initiate, carry through, and analyse projects. Such freedom is, of course, dependent, in great part, on the availability of sufficient money to provide facilities and staff to implement and supervise the desired program.

Educational qualifications and training standards for public health personnel have been raised. The full-time public health worker of the future should be a well trained and qualified person. To relieve such a member of purely routine work requires more appreciation and study of the role of the non-professional clerical and voluntary worker in a well-rounded program.

It appears that public health may proceed in one of two directions. The first is toward centralization of authority at the provincial level, with provincial departments of health directing local programs through subsidy and supervision and with less area participation through official boards of health. The second is for provincial departments, by stimulation and subsidy, to encourage a more active participation on the part of the area itself, with increasing autonomy given to the local authority. It is believed that the latter trend would be in the best interests of all concerned, where full-time services exist, satisfactory programs have been outlined, and facilities and staff are adequate.

In these few paragraphs problems of basic importance to the welfare of public health in Canada are outlined. Certain activities in local health programs are time-consuming and might well be discontinued. Some public health work has become stereotyped and ineffective. The study committee stresses the importance of giving public health workers an opportunity to develop new fields and new methods. How many activities are being continued year after year when a critical review in the light of today's knowledge would call for their discontinuance? How much there is to do that is not being done, because our time is fully occupied in carrying out procedures that have become outmoded! We need to evaluate our local health work and to have the courage to make changes.

The study committee rightly emphasizes the importance of developing the responsibility of local health authorities. The great English Public Health Act of 1875 stressed the fundamental importance of the local health authority. The committee's emphasis upon this is timely because of the growing willingness of the general public to accept services of various kinds, including public health, from governments, without assuming any responsibility for participation.

THE TWELFTH ANNIVERSARY OF THE FOUNDING OF THE
INSTITUTE OF MICROBIOLOGY AND HYGIENE,
UNIVERSITY OF MONTREAL

FOUNDED in 1938 by Professor Armand Frappier, the Institute of Microbiology and Hygiene of the University of Montreal is considered to be the French school of microbiology in North America. The Institute is a development of the BCG Laboratory of the University of Montreal which since 1926 has been a pioneer in vaccination against tuberculosis. A "Research Day", held on October 28th, commemorated the twelfth anniversary of the founding of the Institute. More than three hundred representatives of the Federal and Provincial health departments and research organizations were present.

In the morning there was a tour of the Institute, followed by a lecture on "Properties of the Tubercle Bacillus at its Different Biological Ages", by Dr. Léopold Nègre, of the Pasteur Institute, Paris.

In the afternoon, an outline of the organization and operation of the Institute and its six departments was given by members of the staff.

Professor Armand Frappier explained the general organization of the Institute. All research activities are coordinated in a separate department under his scientific direction. The several investigations on BCG vaccination, initiated in 1926 at the University of Montreal and now carried on intensively at the Institute, have contributed to the use of BCG vaccination in the Province of Quebec and have stimulated interest in BCG in the other Provinces of Canada and in the United States.

Professor Henri Simmonet, of the National Veterinary School at Alfort, France, and the National Institute of Agronomy, Paris, outlined his plan for the development of research on pro-

teins, peptides and amino acids at the Institute of Microbiology and Hygiene. Professor Simmonet teaches in the School of Hygiene for three months of each year and is a scientific adviser at the Institute of Microbiology and Hygiene.

Professor Pierre Lépine, head of the virus service at the Pasteur Institute, Paris, who spends three months each year at the Institute of Microbiology and Hygiene as chief of a similar service, reported on the work of the virus department on neurotropic infections, especially poliomyelitis, epidemiological studies of virus diseases, and the biological properties of viruses.

Mr. Victorien Fredette, associate director and head of the Anaerobes and Fermentations Department, summarized the work of his laboratory on toxino-genesis factors of tetanus bacillus, the metabolism of anaerobes, and the bursting factor of *Welchii perfringens*, which with Dr. Armand Frappier he discovered.

Dr. Jules Gilbert, assistant director of the School of Hygiene, explained how the teaching of the school, an outgrowth of the Institute of Microbiology and Hygiene, extends the influence of the Institute in the field of public health.

Professor Maurice Panisset, associate director and head of the Teaching Department, reviewed the investigations on experimental tuberculosis. The Experimental Tuberculosis Department is separate from the BCG Vaccination Service and has a team of scientists who conduct research, particularly on methods of determining virulence and toxicity of the tubercle bacillus, the standardization of diagnostic methods, paucibacillary infec-

tions, properties of young bacilli, and the methyl antigen.

Messrs. Lionel Forté and Jean Tassé, associate directors and heads, respectively, of the Department for the Production of Biologicals and the Auxiliary Department, pointed out the importance, too often unrecognized, of scientific research in the preparation of biologicals and their control.

The "Research Day" ended with a reception given by the director of the Institute in the *Hall d'Honneur* of the University, and a banquet to the official representatives, tendered by the pre-

sident and the members of the Board of Administration of the Institute. At the banquet a number of distinguished speakers—among them, the Honourable J. A. Asselin, K.C., president of the Board, the Honourable J. H. A. Paquette, Minister of Health for the Province, Professor Léopold Nègre, and Professor Armand Frappier—paid tribute to the outstanding accomplishments of the Institute, emphasizing the value of the services rendered by the Institute to the advancement of public health and mentioning the need for its further expansion.

NEWS

British Columbia

MISS LUCILLE GIOVANDO has returned to the staff of the Department following a year's leave of absence spent at the University of Minnesota during which time she obtained her Master's degree in public health, with special emphasis on mental hygiene. She will act as mental hygiene consultant with the Division of Public Health Nursing.

THE NEW REGULATIONS for the Control of Communicable Diseases were brought into effect during January. They include a number of changes in the quarantine and isolation periods for various diseases. The changes bring the Regulations in line with the recommendations of the American Public Health Association.

DR. ERNEST COUTURE, Director of Maternal and Child Health Services in the Department of National Health and Welfare, and Dr. P. J. P. L'Heureux, Medical Health Officer, St. Boniface, Manitoba, are in British Columbia to consult with Health Department officials about the Wetzel Grid study made in the Central Vancouver Island Health Unit.

IN THE INTEREST of furthering the civilian defence plans of this Province, three British Columbia nurses have been sent to San Francisco to attend a special course on the nursing aspects of atomic warfare. The course started on the twelfth of February

and was concerned with all aspects of atom bomb phenomena, including the biological, medical and public health effects with special emphasis on the role of the nurse. The three nurses sent by British Columbia were Miss Margaret Campbell, assistant director with the Division of Public Health Nursing, Provincial Department of Health and Welfare; Miss F. Trout, of the Registered Nurses Association of British Columbia; and Miss M. E. Henderson, educational director of the Greater Vancouver Metropolitan Health Committee.

THIRTEEN SCHOOL BOARDS have signified their desire to benefit from a preventive dental service by including within the staff of the local health unit a full-time children's dentist. Appointments for dental directors are now in order for the following health units: South Okanagan, North Fraser Valley, Cariboo, and Simon Fraser. Two school districts of the Central Vancouver Island Health Unit have also requested the service. Applications have increased and it is hoped that by the summer at least three or four of the programs will be under way.

Alberta

MISS ALICE THOMPSON has been appointed secretary-technician of the Stettler Health Unit. She succeeds Miss Enid Blakey, C.S.I.(C.), who has taken a new post in Edmonton on a poliomyelitis survey of the Province.

Saskatchewan

THE FIRST ANNUAL CONFERENCE for the field staff of the Provincial Department of Public Health was held in Regina on January 15 to 19 inclusive, under the chairmanship of Dr. F. D. Mott, Acting Deputy Minister. Among the topics dealt with in the general sessions were: the medical care program of the Swift Current Health Region, public health and civil defence, dental programs in Health Regions, hospital services in Saskatchewan. Group sessions were held by the public health nurses, sanitary officers, regional medical health officers, hospital services field staff, regional dental officers, and teacher-psychologists. At the conference dinner, an address on the province's health programs and plans was given by Premier T. C. Douglas, and life memberships in the Saskatchewan Anti-Tuberculosis League were presented to the Hon. T. J. Bentley, Minister of Public Health, Miss Elizabeth Smith, Director of Nursing Services, and Mr. Christian Smith, Director of Health Education.

SASKATCHEWAN'S 100TH UNION HOSPITAL DISTRICT came into being during January in the Rockglen area. Provincial legislation first passed in 1916 permits towns, villages, and rural municipalities to combine in order to establish a special local body, with taxing authority, for the purpose of erecting and maintaining a hospital. Recently the union hospital system has expanded rapidly, with 76 new union districts organized in the past six years. These districts now include well over one-third of the settled area of the province and well over one-third of the population. They provide about one-third of all the province's hospital beds. The strong trend towards union hospital districts, providing a tax-supported base for hospital construction and maintenance, has made hospitals possible in many rural areas of Saskatchewan which could not otherwise have erected and maintained the hospital facilities they required.

DR. B. T. DALE, Director of Preventive Services, attended a special course on civil defence in Washington, D.C., as a medical delegate from Saskatchewan.

A TRAINING SCHOOL for prospective sanitary officers is being conducted during January and February by the Sanitation Division of the Saskatchewan Department of

Public Health. Subjects covered in the four-week course include water and sewage treatment, plumbing, bacteriology, food technology, milk production and processing, and parasitology. Lecturers include Dr. W. A. Riddell, Dean of Regina College; H. E. Robertson, Acting Director of Laboratories; Dr. S. C. Best, Director of Child Health; Dr. M. K. Abelseth, Animal Pathologist; Dr. A. P. Arnason, Dominion Entomological Laboratory, Saskatoon; and members of the division staff. The course involves laboratory work and field inspections. This is the first time such a course has been attempted in the province. The 18 students are all members of the sanitation division staff or health region staffs.

Manitoba

THE OFFICIAL OPENING CEREMONY of the Pilot Mound Nursing Unit was held on January 20 at a public meeting in the Foresters' Hall, Pilot Mound. Dr. M. R. Elliott, director of extension health services, represented the Department of Health and Public Welfare, and Miss E. Russell represented the Nursing Division. This nursing unit is the first to be built in an overall scheme of the Morden Hospital District, of which Pilot Mound is a part. The unit contains 8 beds, a case room and 4 bassinets.

MISS WINNIFRED BARRATT, registrar and consultant for licensed practical nurses, represented Manitoba at the short course on nursing aspects of atomic warfare, held at the University of Minnesota, Minneapolis. Designed to provide a nucleus of trained instructors for professional nurses, the course was devoted to health problems arising from possible atomic attack and the nursing techniques involved.

MR. GRAHAM DAVIS, director of the division of hospitals of the W. K. Kellogg Foundation, Battle Creek, Michigan, and past president of the American Hospital Association, visited Manitoba for talks with public health officials on hospitalization, laboratory and nursing services.

MISS LUCRETIA STEWART, acting vital statistics recorder, left the department in January to be married.

THE MANITOBA BRANCH of the Food Technology Association met recently with the vice-president, René Sanson, and secre-

tary, Reginald Fife, of the Montreal Branch, for the purpose of discussing the possibilities of forming a Canadian Association. The president of the Manitoba branch of the Association is Dr. E. C. Chamberlayne, Director of Food Control.

THE MANITOBA DEPARTMENT OF HEALTH has been engaged for the past two years in a Federal research project, a study of the incidence of nitrates in ground waters in connection with well-water cyanosis in infants. A recent development in this regard has been noted in the Neepawa area. The nitrate concentration of the ground waters there has increased considerably to the point where the Health Unit is having difficulty in finding supplies safe for infant feeding. Nitrate levels as high as 200 p.p.m. (N) have been recorded from some wells. Several cases of cattle poisoning have also been attributed to this situation. In order to study the problem a joint meeting was held recently with representatives of the Provincial Departments of Health and Agriculture and other interested parties. A continuing committee was set up to plan further investigations.

Ontario

A HEALTH UNIT has been established in York County to serve the townships of North Gwillimbury, Georgina, Vaughan and Markham, the towns of Aurora and Newmarket, and the villages of Richmond Hill, Stouffville, Sutton West, Woodbridge and Markham. Dr. R. M. King is medical officer of health of the unit with offices at Newmarket. Mrs. Jean Ross Rhoten has been appointed supervisor of public health nursing. She is a graduate of Toronto Orthopaedic Hospital, the general course in public health nursing and the advanced course in administration and supervision at the University of Toronto.

MUSKOKA DISTRICT has established a health unit which covers all of Muskoka except the Town of Bala and the townships of McLean, Morrison and Watt. Dr. G. K. Martin is medical officer of health of the unit, with offices at Bracebridge. Miss Helen Etherington is supervisor of public health nursing. She is a graduate of the

Mack Training School, St. Catharines, and of the general course in public health nursing and the advanced course in administration and supervision at the University of Toronto. Until last June, Miss Etherington was supervisor of public health nursing with the Kenora-Keewatin Area Health Unit.

MISS CARRIE GENIK, a graduate of the Royal Alexander Hospital, Edmonton, and the general course in public health nursing and the advanced course in administration and supervision at the University of Toronto, has been named supervisor of public health nursing with the Kenora-Keewatin Area Health Unit.

MISS MARY MARSHALL MEADE, a graduate of St. Bartholomew's Hospital, London, England, the health visitor's course, Royal College of Nursing, and the advanced course in administration and supervision, University of Toronto, was recently appointed supervisor of public health nursing for the Dufferin County Health Unit.

MISS MIRIAM MACDONALD, a graduate of Toronto Western Hospital and the general course in public health nursing and the advanced course in administration and supervision, University of Toronto, is now supervisor of public health nursing for the Prince Edward County Health Unit.

Doctor Wallace Troup Succeeds Doctor N. L. Burnette

DR. WALLACE TROUP, associate medical director of the Metropolitan Life Insurance Company at the head office in Ottawa, has taken over the health and welfare work of the company in Canada, succeeding the former director of health and welfare, Norman L. Burnette, D.Sc.S., assistant vice-president. Dr. Burnette retired on January 1st.

Doctor Troup has been with the Metropolitan since 1925. He was appointed assistant medical director in 1928 and an associate medical director in 1945. In his expanded responsibilities, he will cooperate with public health authorities throughout the country and will further the health work of the Metropolitan in medical research and education. He will continue to be in charge of the medical division.

EMPLOYMENT SERVICE

Advertisements regarding "positions available" and "personnel available" will be published in from one to four consecutive issues, depending upon the requirements of the agency or person concerned. They are limited to seventy words or less, with a confidential box number if desired. There is no charge for this service to members of the Association. Health agencies are charged a flat rate of \$10.00 for the advertisements (up to four consecutive issues) and for the service. The rate for non-members is \$5.00. The service includes confidential clearing of information between prospective employer and employee if desired.

Public Health Nurses: The York County Health Unit requires Public Health Nurses for a generalized program. Proximity to Toronto permits possibility of urban living conditions combined with rural work. Write to Dr. R. M. King, York County Health Unit, Newmarket, Ontario. 11/

Sanitary Inspector: Applications are invited from qualified sanitary inspectors for appointment to the Kent County Health Unit which is carrying out a generalized program in southwestern Ontario. Initial salary will be based on experience and qualifications. Liberal car allowance, cumulative sick leave. Apply to Dr. D. C. Smith, Kent County Health Unit, County Building, Chatham, Ontario. 1/

Physicians Wanted: Applications are invited for posts with the Canadian Red Cross Blood Transfusion Service from registered medical practitioners with training in bacteriology or clinical pathology. Administrative experience desirable. All posts carry participating pension, hospitalization, medical services and group life insurance plans. Application forms and full details available from National Commissioner, Canadian Red Cross Society, 95 Wellesley Street, Toronto.

Industrial Nurse: The Bell Telephone Company of Canada requires a bilingual public-health trained nurse for the Laurentian District. Nurse would have her headquarters at Three Rivers. Position available immediately. Please address written applications to Nursing Supervisor, Room 930, 1050 Beaver Hall Hill, Montreal, stating qualifications and experience.

Wanted: Assistant Medical Officer of Health for the City of Ottawa. Salary range \$5,520 to \$6,480. Write to Dr. J. J. Day, M.O.H., City Hall, Ottawa, Ontario.

Medical Officer of Health required for the City of Westmount, Quebec. Generalized public health program. Letters of inquiry requesting details may be forwarded to Mr. N. T. Dawe, Personnel Officer, Westmount City Hall, 4333 Sherbrooke Street, Westmount 6, Quebec. 2/

Wanted: Public Health Nurse: The Elgin-St. Thomas Health Unit invites applications for the position of staff nurse. The present minimum salary is \$1,900.00 plus cost-of-living bonus of \$180.00 a year. Suitable adjustments will be made in salary for experience to a maximum salary of \$2,600.00 and cost-of-living bonus. Car allowance \$720.00 per year. Four weeks' vacation, cumulative sick leave at the rate of 1½ days per month unexpended up to ninety days, admission to pension plan after one year's service, and interest-free loan, if necessary, for purchase of car. Apply Supervisor of Nurses, City Hall, St. Thomas, Ontario.

